IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of	:	**Confirmation No. 1434**
Tetsuroh NAKAMURA et al.	:	Attorney Docket No. 2005_0717A
Serial No. 10/533,392	:	Group Art Unit 2853
Filed April 29, 2005	:	Examiner Sarah Al-Hashimi
LIGHT SOURCE FOR IMAGE WRITING APPARATUS AND PRODUCTION METHOD FOR LIGHT SOURCE	:	**Mail Stop AMENDMENT**

SUBMISSION OF VERIFIED ENGLISH TRANSLATIONS OF PRIORITY DOCUMENTS

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Sir:

Please find submitted herewith verified English translations of priority documents JP 2002-315652, JP 2002-315654 and JP 2002-315653.

Respectfully submitted,

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January 26, 2007

VERIFICATION OF TRANSLATION

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that I have a competent knowledge of the English and Japanese Languages,

that the attached document is a true and correct translation made by me to the best of knowledge and belief of: Japanese Patent Application No. 2002-315652 filed on October 30, 2002 with Japan Patent Office.

Dated This 7th day of December 2006.

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[Document Name] Request for Patent

[Docket Number] 2036740109

[Date of Application] October 10, 2002

[Address] Commissioner of the Patent Office

[IPC] G03G 15/04

B41J 3/21

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[Deposit Account No.] 009483

[Amount of payment] 21,000 yen

[List of Attached Articles]

[Document Name] Specification 1

[Document Name] Drawings 1

[Document Name] Abstract 1

[Number of General Power of Attorney] 9713946

[Proof request] Yes

[Document Name] Description

[Title of the Invention] Light source for image writing apparatus

[Claim or Claims]

[Claim 1] A light source of image writing apparatus including a light emitting element, and a light transmitting means transmitting light emitted from the light emitting element to a photosensitive drum, the light source comprising:

a directivity means for imparting the directivity to the light emitted from the light emitting element; and

the light transmitting means for transmitting to the photosensitive drum the light to which the directivity is imparted by the directivity means.

[Claim 2] The light source of image writing apparatus according to claim 1, wherein the light emitting element and the directivity means are formed in one piece.

[Claim 3] The light source of image writing apparatus according to claim 1, wherein the light transmitting means is a lens; and

the directivity means limits the advancing direction of the light within a range of an angle aperture of the lens.

[Claim 4] The light source of image writing apparatus according to claim 3, wherein the directivity means imparts the directivity to the light by reflecting the light in a light guide according to a difference between the refractive index inside the light guide and the refractive index outside the light guide.

[Claim 5] The light source of image writing apparatus according to claim 4, wherein the light guide has a mesa structure.

[Claim 6] The light source of image writing apparatus according to claim 5, wherein the light emitting element is disposed on an upper surface of the mesa structure;

a bottom of the mesa structure is disposed on a surface of a transparent substrate; and

the light transmitting means is disposed between another surface of the transparent substrate and the photosensitive drum.

[Claim 7] The light source of image writing apparatus according to claim 3, wherein the directivity means imparts the directivity to the light according to a difference between the refractive index inside the light guide and the refractive index outside the light guide when the light is emitted from the light guide inside to the outside.

[Claim 8] The image wiring apparatus according to claim 7, wherein the light guide is a beads

sheet provided with a plurality of projections on a surface of a transparent substrate;

the light emitting element is disposed on another surface of the beads sheet; and

the light transmitting means is disposed between the surface of the beads sheet and the photosensitive drum.

[Claim 9] The light source of image wiring means according to claim 7, wherein the light guide is a micro lens;

the light emitting element is disposed on a surface of a transparent substrate;

the micro lens is disposed between another surface of the transparent substrate and the light transmitting means; and

the light transmitting means is disposed between the micro lens and the photosensitive drum.

[Claim 10] The light source of image writing apparatus according to claim 1, wherein the light emitting element consists of an organic electro luminescence.

[Claim 11] A light source of image writing apparatus including a light emitting element, and a light transmitting means transmitting the light emitted from the light emitting element to a photosensitive drum and forming a latent image thereon, the light source comprising:

the light emitting element of which luminous area is larger than a pixel of the latent image; and

a condensing means for condensing the light emitted from the light emitting element and forming a section of the light on the photosensitive drum to be equal to an area of a pixel of the latent image.

[Claim 12] The light source of image writing apparatus according to claim 11, wherein the light emitting element and the condensing means are formed in one piece.

[Claim 13] The light source of image writing apparatus according to claim 11, wherein the condensing means condenses the light by reflecting the light in a light guide according to a difference between the refractive index inside the light guide and the refractive index outside the light guide.

[Claim 14] The light source of image writing apparatus according to claim 13, wherein the light emitting element is disposed on a surface of the light guide;

another surface of the light guide is disposed on a surface of the transparent substrate; and

the light transmitting means is disposed between the light guide and the photo sensitive drum.

[Claim 15] The light source of image writing apparatus according to claim 13, wherein the light emitting element is disposed on a surface of the transparent substrate;

the light guide is disposed on another surface of the transparent substrate; and

the light transmitting means is disposed between the light guide and the photosensitive drum.

[Claim 16] The light source of image writing apparatus according to claim 11, wherein the condensing means condenses the light by reflecting the light when the light is emitted from the inside of the light guide to the outside according to a difference between the refractive index inside the light guide and the refractive index outside the light guide.

[Claim 17] The light source of image writing apparatus according to claim 16, wherein the condensing means is a cylindrical lens or a micro lens.

[Claim 18] The light source of image writing apparatus according to claim 16, wherein the light emitting element is disposed on a surface of a transparent substrate;

the light transmitting means is disposed between another surface of the transparent substrate and the condensing means;

the condensing means is disposed between the light transmitting means and the photosensitive drum.

[Claim 19] The light source of image writing apparatus according to claim 16, wherein the light emitting element is disposed on a surface of a transparent substrate;

the condensing means is disposed between another surface of the transparent substrate and the light transmitting means; and

the light transmitting means is disposed between the condensing means and the photosensitive means.

[Claim 20] The light source of image writing apparatus according to claim 11, wherein the light emitting element consists of an organic electro luminescence.

[Claim 21] The light source of image writing apparatus according to claim 11, wherein the length of the light emitting element in the sub scanning direction is longer than the length of the pixel in the sub scanning direction.

[0001]

[Detailed Description of the Invention]

[Technical Field] The present invention relates to a light source for an image writing apparatus.

[0002] [Background Art] In order to form a latent image on a photosensitive drum of an electrophotographic printer (laser printer), a light source 603 as shown in Fig. 21 is used. The light source 603 is provided with a substrate 601 extended to the main scanning direction on which light emitting elements 602 consist of a number of LEDs (Light emitting Diode) are formed. The typical light emitting element 602 is LED (light emitting diode). The light source is disposed at a position facing the photosensitive drum with having a light transmitting means, such as lens, therebetween. The light emitted from the light emitting element passes through the light transmitting means and forms the latent image on the photosensitive drum.

[0003] As distinct from the liquid display and the like, when the printer uses the light source, it is necessary to obtain correct focus in order to form the image. Therefore, it is configured that the light transmitting means has a narrow angular aperture and the depth of the focus is kept to be long, and this results that the clear latent image may be formed on the photosensitive drum.

[0004] [Cited document 1] JP 58-46361A

[Cited document 2] JP 58-58566A

[0005] [Problems to be solved by the Invention]

Recently, the laser printer has been provided with a function for printing an image with high resolution. In order to print the image with high resolution, the printer must increase the resolution in the sub scanning direction. This increases the number of the scanning per length unit in the sub scanning direction, with the result that the printing time gets long. To print the image with high resolution in a short time, the exposure time per sub scanning line should be shorten. But in such case, it is not possible to obtain the exposure enough to form the latent image on the photosensitive drum.

[0006] A method of increasing the exposure without slowing down the printing speed is to improve the illuminance on the photosensitive drum. For instance, the light transmission efficiency is improved by enlarging an angle aperture of a lens composing the light transmitting means. However, when the angle aperture was enlarged, the focal depth was made short. Accordingly, it is hard to form a clear latent image on the photosensitive drum 106.

[0007] The present invention has an object to provide a light source for image writing apparatus to form the latent image with high resolution accurately.

[0008] [Means for Solving Problem]

Additionally, the light source of the invention is provided with the directivity means for imparting the directivity to the light from the light emitting element in order to improve the light

transmission efficiency without enlarging the angle aperture. And the directivity means impart the directivity to the light and guides the large amount of light to the light transmitting means.

[0009] According to the above-mentioned configuration, of the light emitted from the light emitting element, the light transmitted through the light transmitting means to the photosensitive drum increases without using the light transmitting means having a large angle aperture, and this improves the light transmission efficiency between the light emitting element and the photosensitive drum. Therefore, the illuminance on the photosensitive drum is improved and it is possible to obtain the exposure enough to form the latent image on the photosensitive drum, and the accurate latent image can be formed on the photosensitive drum.

[0010] [Best modes for carrying out the invention]

A light source for image writing apparatus in the invention is applied to the color laser printer (which is called a printer hereinafter) 100 shown in Fig. 1. like the conventional way. The printing process by the printer 100 is described hereinafter.

[0011] A recording paper 120 on a tray 101 is fed to a traveling route 103 inside the printer 100 by a carrying roller 102. While the carrying roller 120 is carrying the recording paper 120, a visible image is formed on the photosensitive drum 106.

[0012] The process forming the visible image is as follows. An electric discharger 105 as shown in Fig. 2 removes the latent image previously formed on the photosensitive drum 106, and the whole photosensitive drum 106 is electrostatically charged by an electric charger 107. Next, the writing light emitted from the light source 200 of the invention forms the latent image on the photosensitive drum 106. Finally, a developing device 108 allows toner to attach to the photosensitive drum 106 and the visible image is formed.

[0013] The printer 100 performs the printing using four colors, Y (yellow), M (magenta), C (cyan) and B (black), and provided with 4 sets of the electric discharger 105, the photosensitive drum 106, the electric charger 107, the light souce 200, and a developing unit 108.

[0014] The visible image formed on each photosensitive drum 106 is transcribed on the recording paper 120 on the traveling route 103, and then a fixing device 109 fixes the visible image thereon. After that, the recording paper 120 is outputted from the printer 100.

[0015] The light source 200 for the image writing apparatus of the invention, which is used in the above printer as the light source, employs following structure. In the under-mentioned description, the light source 200 for the image writing apparatus in this invention is applied to the color laser printer 100. The light source for the image writing apparatus in this invention can be applied to

the laser printer for the monochrome printing, too.

[0016] (Embodiment 1)

The light source 200 of the present invention is provided with a transparent substrate 201 and the light transmitting means 300 that are extended to the main scanning direction as shown in Fig. 3. The transparent substrate 201 and the light transmitting means 300 are supported respectively by a housing of the printer 100, or either of the transparent substrate 201 or the light transmitting means 300 is supported by the housing, and both the transparent substrate 201 and the light transmitting means 300 are fixed to the printer 100 by being connected by a spacer or the like not illustrated in the drawings.

[0017] The transparent substrate 201 is provided with a number of small projections 202d with the mesa structure of the frustum as shown in Fig. 4 in the main scanning direction at fixed intervals. The transparent substrate 201 and the small projections 202d are formed in one piece. For instance, when the light source 200 can print out an image with 2400 dpi, the distance between the small projections 202d is about 10 μm.

[0018] The respective small projections 202d may be formed on the transparent substrate 201 to be the substrate according to a following etching processing, or by embossing the resin, or may be formed with the transparent substrate 201 in one piece by the injection molding.

[0019] The shape of the small projection 202d may not be the frustum, but may be a shape wherein angles G and H, each angle formed by the transparent substrate 201 and a side surface 202c of the small projection 202d as shown in Fig. 7, make an acute angle. That is to say, the shape may apply a frustum, a triangular frustum, a pentagonal frustum, or a polygonal frustum. The material of the small projection 202d is to be permeable and preferably have the same refractive index as the light emitting element 8 of the light source 200. Besides, this embodiment is based on the organic EL (Electro Luminescence) with the refractive index, about 1.7, as the light emitting element, therefore, the material of the projection 202d in this embodiment is preferable to be the refractive index of about 1.7.

[0020] The light emitting element 8 shown in Fig.5(C) is formed on an upper surface 202a of each small projection 202d according to the method as mentioned hereinafter.

[0021] On a whole upper surface of the transparent substrate 201 on which the small projections 202d are disposed, the transparent electrode layer 2 is applied as shown in Fig. 5(A). Next, a position which is on a center of the upper surface 202a of each small projection 202d, is masked by a shading film 3. And the transparent electrode layer 2 is subjected to the photolithography like

the exposure, the development, and the etching. After the photolithography, the transparent electrode layer 2 is removed from the parts on which the shading film was not laminated, as shown in Fig. 5(B), and the masked parts becomes the transparent electrode elements 1.

[0022] Subsequently, the organic EL layer 4 is applied on the whole surface of the transparent substrate 201 on which the transparent electrode elements 1 are formed as shown in Fig. 5(C), and on the organic EL layer 4 the metal electrode layer 5 is applied as the common electrode. The part of the organic EL layer 4 sandwiched between the metal electrode layer 5 and the transparent electrode element 1 becomes the light emitting element 8.

[0023] To protect the organic EL layer 4 from the physical impact and the moisture, the sealing section 204 is applied with adherent resin 6 such as epoxy resin including glass filer, and the sealing glass 7 covers the rear surface of transparent substrate 201 on which the transparent electrode elements 1, the organic EL layer 4, and the metal electrode layer 5 are formed, as shown in Fig. 5(D). Besides, a space 9 surrounded by the metal electrode layer 5, the resin 6, and the sealing glass 7 may be under vacuum or be filled with nitrogen.

[0024] As the transparent substrate 201 shown in Fig. 3, another surface (front surface) opposite to the surface on which the small projections 202d are disposed is placed so as to face to the photosensitive drum 106 sandwiching the light transmitting means 300.

[0025] The light transmitting means 300 consists of a lens array binding a plurality of lens like a fiber lens 303, a rod lens, or a micro lens. Besides, the lens used to the light transmitting means may be an image transmitting type or a type of transmission for the light intensity. In this embodiment, the light remitting means 300 uses a fiber lens array of biding plural fiber lenses 303 shown in Fig. 3(A) to Fig. 3(C).

[0026] As shown in Fig. 6(A) and 6(B), the fiber lens array is formed by disposing a plurality of the fiber lenses 303, of which each axis is perpendicular to an axis of the photosensitive drum 106, in each space surrounded by two base frames 301, and the gaps between the fiber lenses 303 are filled with opaque resins. The light absorbing layer 302 is provided in order to prevent the crosstalk between the fiber lenses 303, but it is possible to obtain the same effect by applying the opaque resins to be the light absorbing layer 302 on the circumference of each fiber lens 303. In addition, the crosstalk can be prevented by using both the light absorbing layer 302 provided between the base frames 301 and the light absorbing layer 302 applied on the circumference of the fiber lens 303.

[0027] Under the above-mentioned configuration, when a predetermined voltage is impressed

between the transparent electrode element 1 and the metal electrode layer 5 of the light source 200, the light emitting element 8 emits the light. The rays A, B and C thus emitted from the light emitting element 8 come from the upper surface 202a of the small projection 202d into the small projection 202d through the transparent electrode element 1 as shown in Fig. 7.

[0028] Of the rays A, B and C which come into the small projection 202d, the ray A of which incident angle $\theta 1$ on the upper surface 202a is small, that is, the advancing direction of the ray A is the same as or approximate to the axis direction of the fiber lens 303. Accordingly, the ray does not reflect within the small projection 202d but emits from the bottom 202b of the small projection 202d into the transparent substrate 201. On the other hand, the rays B and C, of which incident angles $\theta 1$ are large, are incident from the upper surface 202a, and reach the side 202c of the small projection 202d.

[0029] Since the refractive index of the small projection 202d is 1.7 that is larger than the space 9 under vacuum or filled with the nitrogen, and the angles $\angle G$ and $\angle H$ are acute angles as shown in Fig. 18 as described above, an incident angle $\theta 2$ that the rays B and C with the large incident angle $\theta 1$ forms on the side 202c of the small projection 202d becomes large. In result, it is likely that the ray with large incident angle $\theta 1$ like the rays B and C performs the total reflection on the side 202c. By the total reflection, the rays B and C are imparted with the directivity close to the axis direction of the fiber lens 303, and then emitted from the bottom 202b to the transparent substrate 201.

[0030] Therefore, the advancing direction of each ray passing through the small projection 202d gets approximate to the axis direction of the fiber lens 303, as compared with the direction before the ray is incident into the small projection 202d. That is to say, the advancing direction of the ray emitted from the light emitting element 8 get converging within the range of the angle aperture of the fiber lens 303.

[0031] The ray discharged from the lower bottom of the small projection 202d comes into the light transmission means 300 through the transparent substrate 201.

[0032] Since the advancing directions of most of light reaching the light transmitting means 300 are steered to the same as the axis direction of each fiber lens 303 composing the light transmitting means 300, even if the angle aperture of the fiber lens 303 is small, each ray of light is led into the light transmitting means 300, and illuminates the photosensitive drum 106 through the light transmitting means 300.

[0033] When the small projection 202 is used as a directivity imparting means, the light

transmission efficiency between the light emitting element 8 and the photo sensitive drum 106 could be improved about a four times as high as the configuration of forming the transparent electrode element 1 on the transparent substrate 201.

[0034] Because of the use of the directivity means like the small projection 202d, it is not necessary to make the angle aperture of the fiber lens 303 large in order to improve the light transmission efficiency. Accordingly, the light transmitting means 300 can keep a long focal depth. The light source can form a clear latent image on the photosensitive drum 106 with ease.

[0035] The above-mentioned etching is a dry etching for forming the mesa structure, for example.

[0036] When the small projection 202d is formed by the dry etching, a material to be a directivity imparting layer 801 is applied or evaporated on the whole surface of the transparent substrate 201 as shown in Fig. 8(A). The material of the directivity imparting layer 801 is the same as the small projection 202d. In the next step, the transparent electrode layer 2 is formed on the upper surface of the directivity imparting layer 801 by the coating or the evaporation. Regarding the transparent substrate 201 on which the transparent electrode layer 2 is formed as above, a reacting species is brought to a side forming section (sections 808) through a mask 809 for controlling the depth of the etching, as shown in Fig. 8(B). The mask 809 is a metal mesh of which opening is adjusted in size according to the depth of the etching. That is to say, some parts of the metal mesh corresponding to the deep etching part (the center of the section 808) have a large size of aperture to increase the brought amount of the reacting species, while the other parts corresponding to the shallow etching part (the end portions of the section 808) have a small size of aperture to reduce the brought amount of the reacting species.

[0037] (Embodiment 2)

The above-mentioned directivity means may be configured by a beads sheet 220 of which projections are formed on a surface of the transparent substrate 201 extended to the main scanning direction by the injection molding, said surface facing to the light transmitting means 300, as shown in Fig. 9. In the case of using the beads sheet 220 as the directivity means, the light emitting elements 8 are formed on another surface of the beads sheet 220 opposite to the surface on which the projections are formed, according to the following method.

[0038] First, the transparent electrode layer 2 is applied on the whole surface of the beads sheet 220, which is opposite to the surface with the projections, as shown in Fig. 10(A). And then, a position to form the transparent electrode element 1 on the transparent electrode layer 2 is covered

with the shading film 3, like Embodiment 1.

[0039] And the photolithography is performed, which forms the transparent electrode element 1 on the part masked by the photolithography, as shown in Fig. 10(B). After that, the organic EL layer 4 and the metal electrode layer 5 are formed in the same way as Embodiment 1. In result, the organic EL layer 4 sandwiched between the transparent electrode element 1 and the metal electrode layer 5 becomes the light emitting element 8. Besides, like Embodiment 1, for the purpose of protecting the organic EL layer 4 from the physical impact and the moisture, the resin 6 is applied on the sealing section 204, and the metal electrode layer 5 and the resin 6 are covered by the sealing glass 7, as shown in Fig. 10(C).

[0040] Under such configuration, the ray A emitted from the light emitting element 8 is incident into the beads sheet 220 through the transparent electrode element 1 as shown in Fig. 11. The beads sheet 220 is provided with the projections on the surface facing to the light transmitting means 300. There is a possibility that the ray A, at the time of going out from the beads sheet 220, has a smaller angle against the projection than when the ray A is emitted from the surface without projections. Therefore, the projections can reduce the leakage of the light emitted from the beads sheet 220, with the result that it is possible to increase the volume of emitted from the beads sheet 220 to the light transmitting means 300.

[0041] When the light is emitted from the beads sheet 220, the light is imparted with the directivity because of the difference of the refractive index between the beads sheet 220 and the outside. That is to say, the light of which advancing direction inclines to the axis direction of the fiber lens 303 steers the advancing direction close to the direction as the axis direction of the fiber lens 303.

[0042] The use of the beads sheet 220 as the directivity means as described above can emit a large volume of light as well as can impart the directivity to the light. In result, the light transmission efficiency between the light emitting element 8 and the photosensitive drum 106 could be improved about a twice as high as the use of the transparent substrate 200 without the projections.

[0043] Besides, the projection provided with the beads sheet 220 may be a shape that is able to impart the light with the directivity as well as emit larger volume of light from the beads sheet 220 to the light transmitting mans, such as a cone, a frustum of a cone, a dome, a triangular pyramid, a rectangular pyramid, and so on.

[0044] And the size of the projection of the beads sheet 220 is not limited in particular, but it is

desirable to be smaller than the light emitting element 8. For instance, if the size of the projection is the same as the light emitting element 8, the assembling of the light source 200 requires a step of the positioning to correspond the projection to the light emitting element 8 so that the light from the light emitting element 8 might be discharged from one projection. But, as smaller the projection is in size, the number of the projections through which the light from each light emitting element passes becomes approximate to the number of the light emitting elements 8 without the positioning of the projection and the light emitting element 8. Therefore, it is possible to diminish the dispersion of the directivity to be imparted to the light from each light emitting element 8, and the alignment of the projections can be eliminated.

[0045] Moreover, since the beads sheet 220 is provided with functions of both the directivity means and the transparent substrate 201 as described above, the process of disposing the small projection 220d can be eliminated in the assembling process of the light source 200 using the bead sheet 220, like Embodiment 1.

[0046] (Embodiment 3)

In Embodiment 2, instead of the beads sheet 220 with the projections provided to the transparent substrate 201 as the directivity means, a micro lens array 230 may be disposed between the transparent substrate 201 and the light transmitting means 300 as the directivity means, as shown in Fig. 12.

[0047] The producing process for forming the light emitting element 8 on the transparent substrate 201 is the same as in Embodiment 2 except for a step that the light emitting element 8 is formed on the transparent substrate 201 without the projections.

[0048] The micro lens array 230 to be used as the directivity means is produced by the injection molding or by irradiating the ultraviolet rays on the photosensitive glass.

[0049] The micro lens array 230 is supported by the transparent substrate 201 through the spacer S as shown in Fig. 12, for example.

[0050] The light from the light emitting element 8 are incident to the micro lens array 230 through the transparent substrate 201. And when the light is emitted from the micro lens array 230, the advancing direction of the light is converted in the same way as emitting the light from the beads sheet 220. And most advancing directions of the light approximate to the axis direction of the fiber lens 303.

[0051] Besides, the size of the micro lens is not limited in particular. But it is desirable to be smaller than the transparent electrode element 1 like the size of the projection of the beads sheet

220. This makes it easy to assemble the light source.

[0052] (Embodiment 4)

The above embodiment relates to the configuration so as to improve the transmission efficiency of the light between the light emitting element 8 and the photosensitive drum 106 by changing the advancing direction of the light, and the illuminance on the photosensitive drum. The following explains about the configuration so as to improve the illuminance on the photosensitive drum by improving the luminous intensity of each light emitting element 8.

[0053] In order to improve the luminous intensity of each light emitting element 8, the respective light emitting elements 8 in this embodiment have a large luminous area. As described above, in order to print an image with high resolution, each light emitting element 8 must be disposed at a small interval in the main scanning direction. Accordingly, the length of the light emitting element 8 in the main scanning direction is limited.

[0054] However, the length of the sub-scanning direction is not limited as above. By extending the length of the light emitting element 8 in the sub scanning direction, the size of the light emitting elements 8 can be enlarged. In case of using the light emitting element 8 being long in the sub scanning direction, the sectional view of the light emitted from the light emitting element 8 gets long section in the sub-scanning direction, and the pixel of the latent image formed on the photosensitive drum 106 has been extended to the sub-scanning direction. Accordingly, the length of the section of the light in the sub-scanning direction, the light emitted from the light emitting element 8, must be the same as the one in the main scanning direction.

[0055] In this embodiment, the light guide 240 is used as a condensing means for condensing the light from the light emitting means 8 into the sub-scanning direction, as shown in Fig. 13.

[0056] The material of the light guide240 has a refractive index higher than that of the transparent substrate 201. The reflection material 245 not permeable to light is layered over the surface 244 opposite to the emitting surface 245 of the light guide 240.

[0057] The light guides 240 are disposed on the transparent substrate 201 in the main scanning direction at fixed intervals. The fixed intervals are the same as the intervals of pixels of the printing image. Besides, in order to avoid the crosstalk of the light incident to each light guide 240, the space between the light guides 240 may be formed as an air layer or filled with the material having the refractive index smaller than the light guide 240.

[0058] The light emitting elements 8 are formed on each light guide 240 in the same way as forming the light emitting element 8 on the small projection 202d in Embodiment 1. It is sure

that the sealing section 204 is applied with the adhesive resin 6 such as the epoxy resin including glass filer, and the metal electrode layer 6 and the resin 6 are covered with the sealing glass 7 in order to protect the organic EL layer 4 from the physical impact and the moisture, which is not shown in Fig. 13.

[0059] In a sectional view (Fig. 14) of Fig. 13, the ray D emitted from the light emitting element 8 is incident to the light guide 240 through the transparent electrode element 1. It is configured that the light guide 240 has the refractive index larger than the transparent substrate 201, a vacuum status, or the air, and the reflection material 245 is layered over the surface 244 opposite to the light guide 240. The ray D incident to the light guide 240 is reflected within the light guide 240 repeatedly, and then the ray exits from the emitting surface 241.

[0060] Therefore, the section of the emitting surface 241 may be formed so as to have the same area as the area required to the pixels of the latent image formed on the photosensitive drum 106. In result, even if the luminous surface of the light emitting element 8 has any shape, the section of the light emitted from the emitting surface 241 is the same area as required.

[0061] Accordingly, the larger the luminous area of the light emitting element 8 becomes, the more the luminous flux density of the light emitted from the emitting surface 241 can increase. Since the length of the ray emitting element 8 in the sub scanning direction is not limited in particular as mentioned above, the light emitting element 8 may be formed on the light guide 240 so as to be long in the sub scanning direction. This makes it possible to obtain the high luminous flux density on the emitting surface 241.

[0062] The light source 200 provided with the light guide 240, wherein the light is emitted from the emitting surface 241, is provided with the light transmitting means 300 in front of the light emitting surface 241 as shown in Fig. 13. The light emitted from the emitting surface 241 illuminates the photosensitive drum 106 through the light transmitting means 300 in the same way as described in Embodiments 1 through 3.

[0063] Therefore, the use of the condensing means makes it possible to obtain the light with high luminous flux density even in the light source 200 wherein the light emitting elements 8 are formed in the main scanning direction at short intervals. Therefore, the light source with the condensing means can form the latent image with the high resolution.

[0064] Additionally, the light with the high luminou flux density can be obtained without reducing the luminescence life of the light emitting element 8 by using the light guide 240 as the condensing means, because it is not necessary to apply a large electric field on the transparent

electrode element 1 and the metal electrode layer 5 in order to obtain the light with the high luminous flux density as conventionally.

[0065] Moreover, the shape of the light guide 240 is not limited to a rectangular parallelepiped shown in Fig. 13. For instance, the shape may be a polygonal prism like a pentagonal prism and a hexagonal prism, or a shape with polygonal bottom and upper surface of frustum of a cone as shown in Fig.15.

[0066] Besides, although the light guide 240 may be produced by the injection molding, it may be produced by the etching as follows. For instance, a material 242 to be the light guide 240 is applied on the transparent substrate 201, and then the transparent electrode layer 2 is applied thereon, as shown in Fig. 16(A). Next, the position to form the transparent electrode element 1 on the transparent electrode layer 2 is masked by the shading layer 3, and then the transparent electrode layer 2 and the material 242 are subjected to the etching. Hereupon, the transparent electrode element 1 and the light guide 240 are produced as shown in Fig. 16(B).

[0067] As described above, since the section area of the light emitted from the light emitting element 8 can be made to be the same size as the pixels of the latent image by the light guide 240, if the light guide 240 is disposed so that the emitting surface 408 be closer to the photosensitive drum 106, the light source 200 does not need to be provided with the transmitting means 300.

[0068] And if the emitting surface 241 is a convex surface such as the convex lens, the light through the emitting surface 241 is allowed to form an image on the photosensitive drum 106. It is nevertheless to say that it is not necessary to provide the light source 200 with the light transmitting means 300 if the emitting surface 241 is convex.

[0069] (Embodiment 5)

A convex cylindrical lens 250 may be applied to the condensing means, instead of the light guide 240. In such case, the cylindrical lens 250 may be disposed between the light transmitting means 300 and the photosensitive drum 106 so as to face the curved surface to the photosensitive drum 106 as shown in Fig. 17. The cylindrical lens 250 should be supported by the light transmitting means 300 through a spacer not shown in the drawing, or by a housing of the printer 100.

[0070] The light emitting element 8 may be formed on the transparent substrate 201 in the same way as Embodiment 2, but the light emitting element 8 in this embodiment is longer in the sub scanning direction than in the main scanning direction, which is different from embodiment 2. The length of the light transmitting element 8 is long in the sub scanning direction because the

main scanning direction is limited as described in Embodiment 4. Besides, Fig. 17 does not show, but it is also a matter of course in this embodiment that the metal electrode layer 5 may be covered by the resin 6 and the sealing glass 7 in order to protect the organic EL layer 4.

[0071] As shown in Fig. 17, the light emitted from the light emitting element 8 is incident into the cylindrical lens 250 through the transparent substrate 201 and the light transmitting means 300. The light incident to the cylindrical lens 250 is narrowed down to the sub scanning direction when the light exits from the convex surface of the cylindrical lens. And the section of the light on the photosensitive drum has the same length both in the main scanning direction and the sub scanning direction.

[0072] If the cylindrical lens 250 is used as the condensing means, it is possible to freely change the length of the section of the light in the sub scanning direction on the photosensitive drum 106 by adjusting the radius of curvature or the refractive index of the cylindrical lens 250, or by adjusting the distance between the cylindrical lens 250 and the photosensitive drum 106.

[0073] Therefore, like Embodiment 4, if it is configured so that the length of the light emitting element 8 is as long as possible in the sub scanning direction, and the cylindrical lens 250 is adjusted in the radius of curvature and the refractive index, and the distance between the cylindrical lens 250 and the photosensitive drum 106 is adjusted, whereby it is possible to obtain the light with the high luminous flux density on the photosensitive drum 106. However, when the length of the sub scanning direction gets short, the focal length of light in the sub scanning direction gets short and there is large difference between the focal length in the sub scanning direction and the focal length of the main scanning direction. And then, it is not possible to obtain a clear latent image on the photosensitive drum 106.

[0074] Besides, the description in Embodiment 5 relates to the case where the convex cylindrical lens 250 is used as the condensing means. But, instead of the convex cylindrical lens 250, the micro lens ally 260 may be used as the condensing means.

[0075] The micro lens ally 260 as the condensing means is formed as shown in Fig. 18 so that the micro lenses may be arranged in a line in the main scanning direction, the shape of each micro lens is a oval of which long axis is in parallel with the sub scanning direction. The purpose of forming such oval is to narrow the light down to the sub scanning direction.

[0076] The cylindrical lens 250 or the micro lens array 260 is disposed between the light transmitting means 300 and the photosensitive drum 106 in Fig. 17 and Fig. 18, however, the cylindrical lens 250 or the micro lens array 260 may be disposed between the transparent substrate

201 andthe light transmitting means 300. In such case, the cylindrical lens 250 or the micro lens array 260 can work as the condensing means.

[0077] In addition, if the light transmitting means 300 is composed of the image transmitting type of lens, the light transmitting means 300 may be disposed just above the cylindrical lens 250 or the micro lens ally 260.

(Embodiment 6)

In Embodiments 1 through 5, respective layers are formed in the order, the transparent electrode element 1, the organic EL layer 4, and the metal electrode layer 5. Therefore, the light emitted from the light emitting element 8 is discharged to the side of the transparent substrate 201 as shown in Fig. 3.

[0078] But, the light source 200 may emit the light to another side opposite to the direction described in Embodiments 1 through 5, that is to say, the light may be emitted upwardly in Fig. 3.

[0079] Since the light emitting element 8 is provided with the opaque metal electrode layer 5 on the upper side as described in Embodiment 1 through 5, the light cannot be emitted upwardly. In order to improve the light emitting efficiency of the organic EL, the cathode must use the material of which work function is lower than the transparent electrode element 1 to be the anode, and the opaque metal electrode layer 5 is used as the cathode.

[0080] Now, in order to emit the light upwardly, the metal electrode layer 5 is formed so as to have a thickness (about 100Å) as far as the light is transmitted, as shown in Fig. 19. Thereby, the light can be emitted upwardly. But, the light is allowed to be discarded downwardly, too. To avoid the light discharging downwardly, the reflection material 210 is provided between the transparent substrate 201 and the transparent electrode element 1.

[0081] Besides, in the above embodiments, the electrode layer 5a is formed on the metal electrode layer 5 so as to flow the electric current uniformly on the thin metal electrode layer 5. And also in this embodiment, the organic EL layer 4, the metal electrode layer 5 and the electrode layer 5a are covered with the resin 6 and the sealing glass 7 for the protection of the organic EL layer 4.

[0082] As described above, the small projection 202d or the light guide 240 is formed on the electrode layer 5a, and the sealing glass 7 covers the light emitting element 8 and the small projection 202d, or the light guide 240, which are shown in Fig. 20(A) and Fig. 20(b).

[0083] [Effect of the Invention]

Since the light source of the present invention is provided with the directivity imparting

means for imparting the directivity to the light emitted from the light emitting element, the large amount of light can be transmitted to the photosensitive drum through the light transmitting means without enlarging the angle aperture of the light transmitting means. With keeping the focal depth of the light transmitting means, the light transmission efficiency between the light emitting element and the photosensitive drum can be improved, so that it is possible to increase the illuminance on the photosensitive drum and to form the accurate latent image on the photosensitive drum.

[0084] The light emitted from the light emitting element with large light emitting area is condensed by passing through the condensing means, so that the it is possible to obtain the light with high luminous flux density by using the condensing means. As the light source is provide with the condensing means and the light emitting element extended long in the sub scanning direction, the light emitted from the light emitting element is condensed in the sub scanning direction, and the light with high luminous flux density can be obtained at short intervals in the main scanning direction. Therefore, it is possible to form the latent image with high resolution on the photosensitive drum.

[Brief Description of the Drawings]

[Fig. 1] is an outline view of the printer provided with a light source of image writing apparatus of the present invention.

[Fig. 2] is an enlarged view of the light source part.

[Fig. 3] is an outline view of the light source and the photosensitive drum of the image writing apparatus in the invention.

[Fig. 4] is an outline view of the transparent substrate on which small projections are formed.

[Fig. 5] shows a process of producing the light emitting element.

[Fig. 6] shows a structure of the light transmitting means.

[Fig. 7] shows a track of the ray of light emitted from the light emitting element.

[Fig. 8] shows a process of producing a small projection by means of the anisotropic etching.

[Fig. 9] is a general view of a bead sheet and the light transmitting means.

[Fig. 10] shows the production process of forming the light emitting element on the bead sheet.

[Fig. 11] shows a track of the ray of light emitted from the light emitting element.

[Fig. 12] shows the light source of the image writing apparatus using a micro lens array as the directivity means.

[Fig. 13] is an outline view of the light source and the photosensitive drum of the image writing means using a micro lens array as the directivity means.

[Fig. 14] shows a track of the ray of light emitted from the light emitting element.

[Fig. 15] shows a track of the ray of light emitted from the light emitting element.

[Fig. 16] shows a process of producing a light guide by means of the anisotropic etching.

[Fig. 17] is an outline view of the light source and the photosensitive drum using a cylindrical lens as the condensing means.

[Fig. 18] is an outline view of the light source and the photosensitive drum using a micro lens as the condensing means.

[Fig. 19] is an enlarged diagram of a periphery of the ray of light emitting element when the ray of light emitted from the light emitting element is emitted to the metal electrode layer side.

[Fig. 20] is a diagram showing the light source when the ray of light emitted from the light emitting element is emitted to the metal electrode layer side.

[Fig. 21] is a general view of the conventional light source.

[Explanation of letters or numerals]

1	transparent electrode element
4	organic EL layer
5	metal electrode layer
8	light emitting element
100	printer
106	photosensitive drum
200	light source
201	transparent substrate
202d	small projection
220	bead sheet
230, 260	micro lens
240	light guide
250	cylindrical lens
300	light transmitting means

[Document Name] Abstract

[Summary]

[Problem to be solved] In order that the laser printer performs the high-resolution printing, the light emitting elements must be disposed at short intervals, however, if the printing speed gets down under such configuration, it is hard to obtain enough exposure to form the latent image.

[Solution] The light transmitting means converts the advancing direction of light emitted from the light emitting element to the direction to be transmitted, whereby the illuminance of the photosensitive drum can be improved. Otherwise, the light emitted from the light emitting element is condensed by enlarging the light emitting area of the light emitting element, whereby the luminous flux density can be improved

[Selected Drawing] Fig. 3

FIG. 1

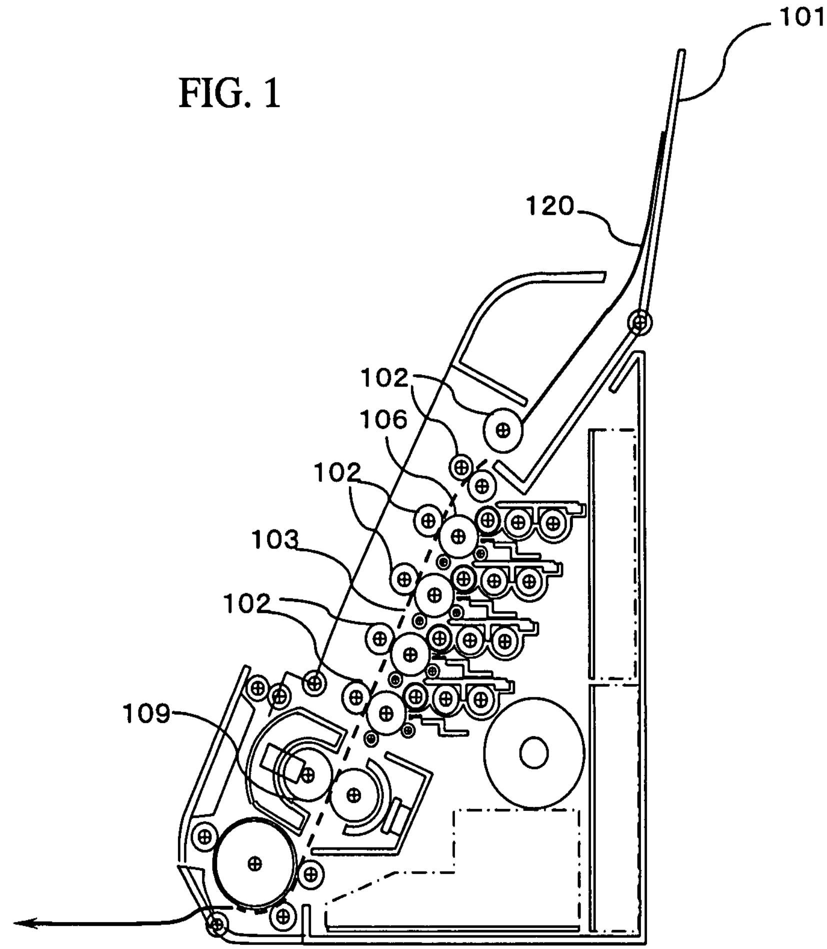


FIG. 2

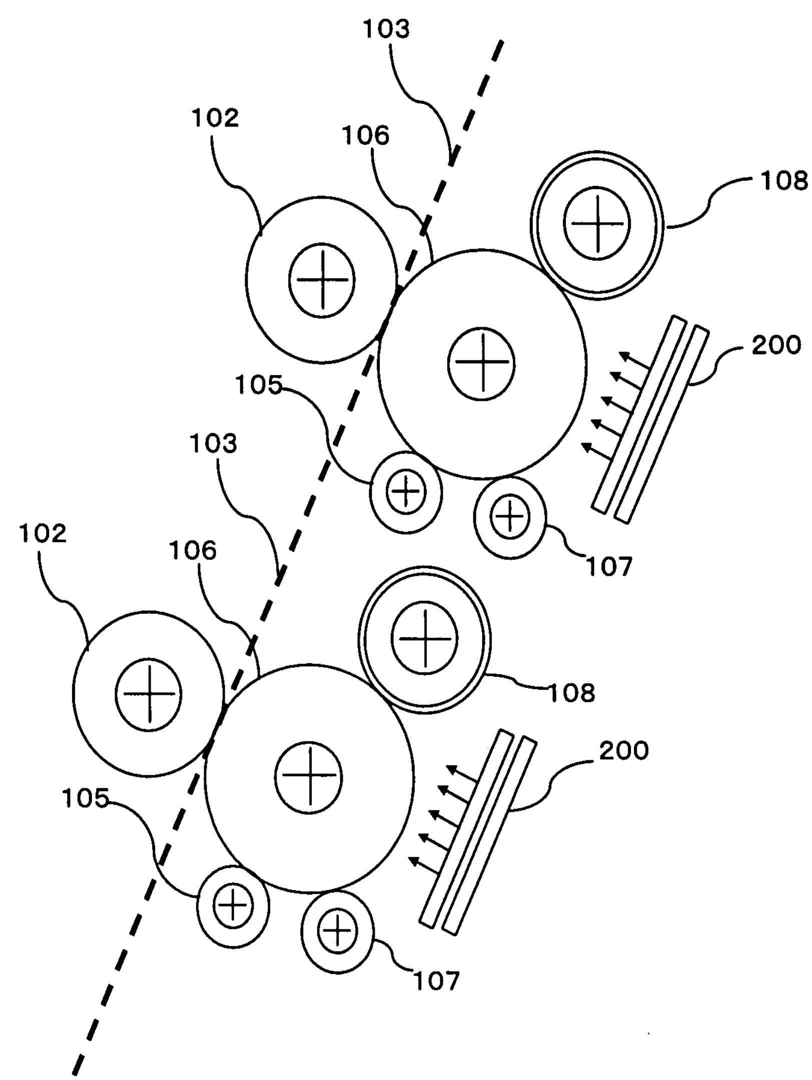


FIG. 3

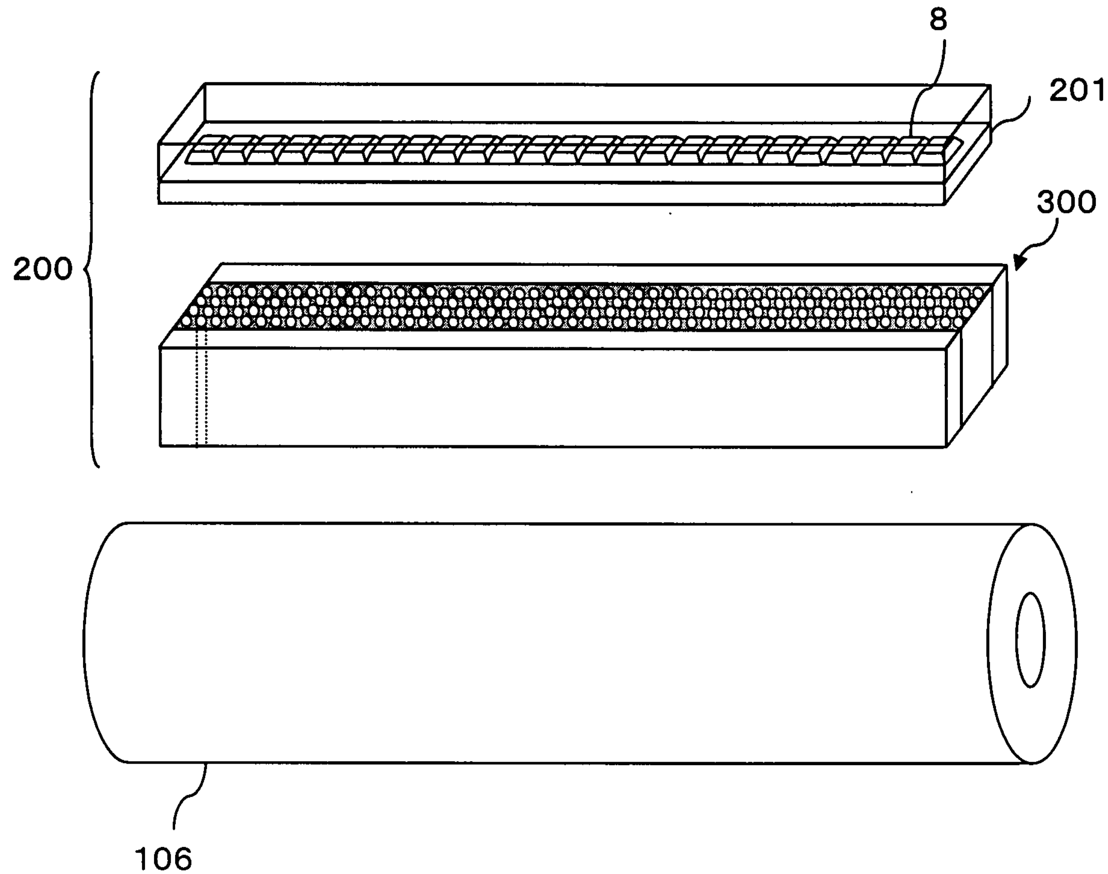


FIG. 4

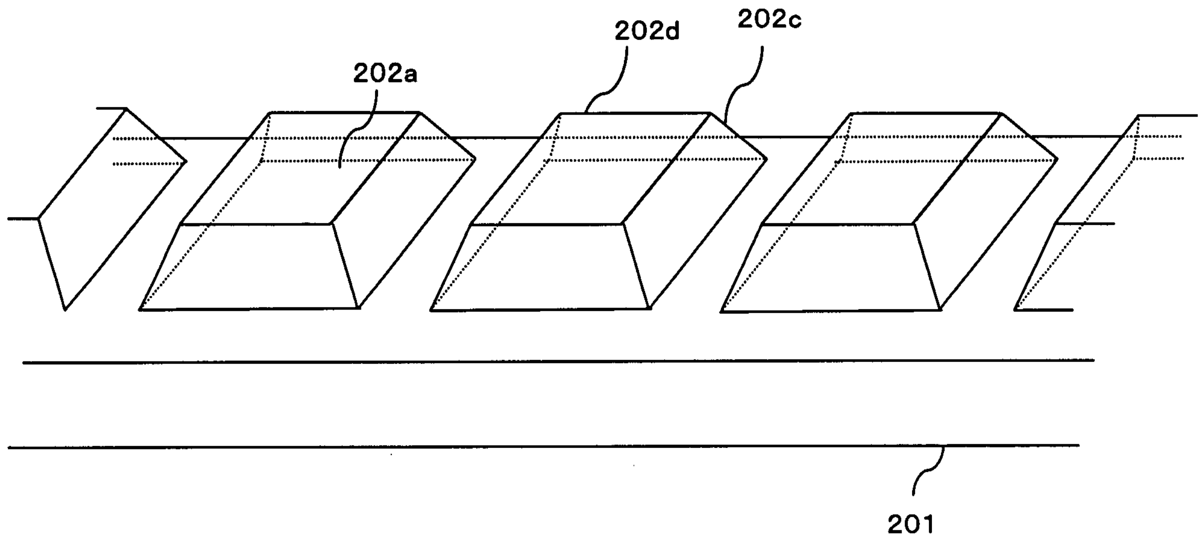
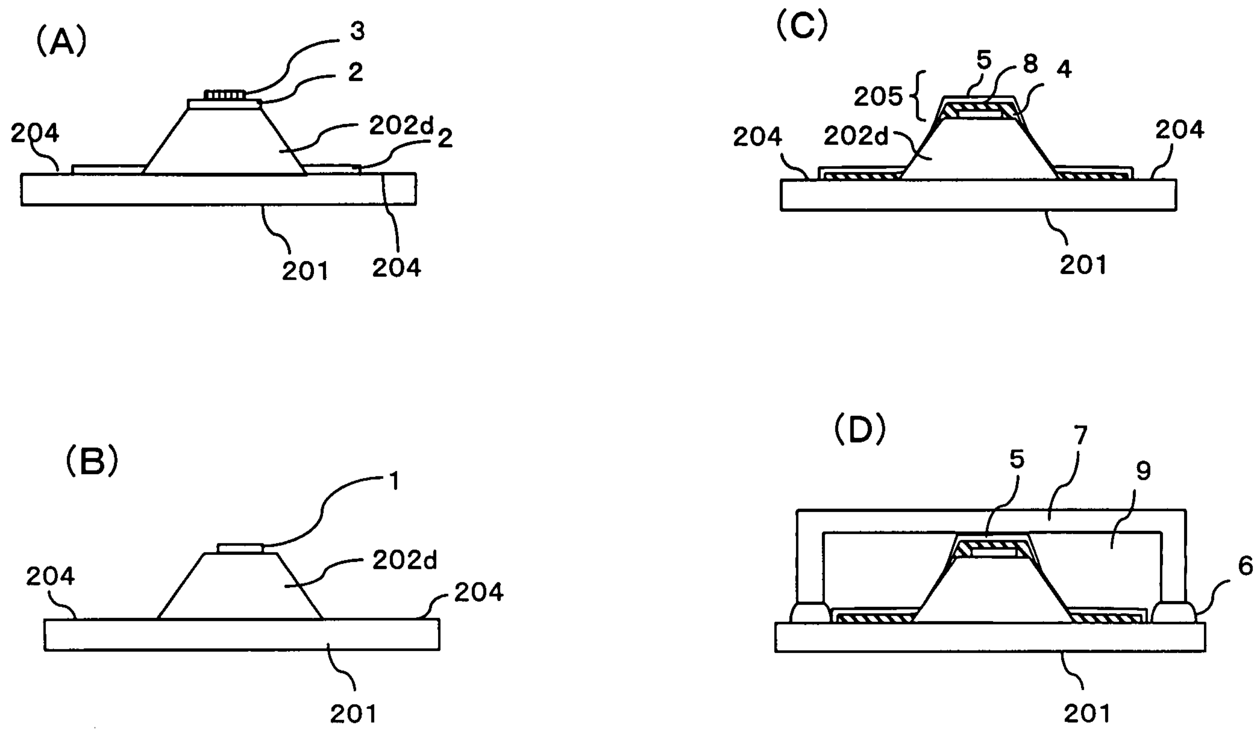


FIG. 5



(A)
3
2
202d
2
204
201
204
(B)
1
202d
204
204
201
(C)
205
5
8
4
204
202d
204
201
(D)
7
5
9
6
201

FIG. 6

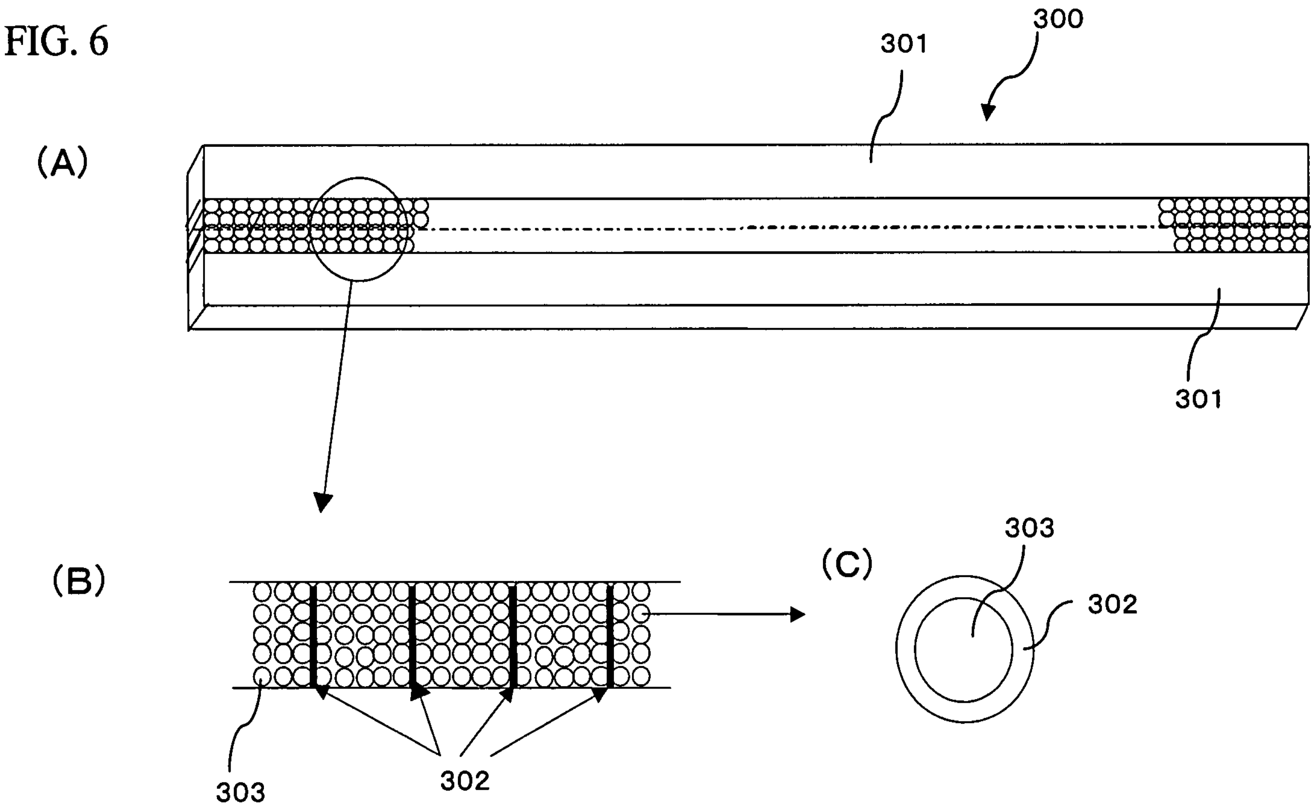


FIG. 7

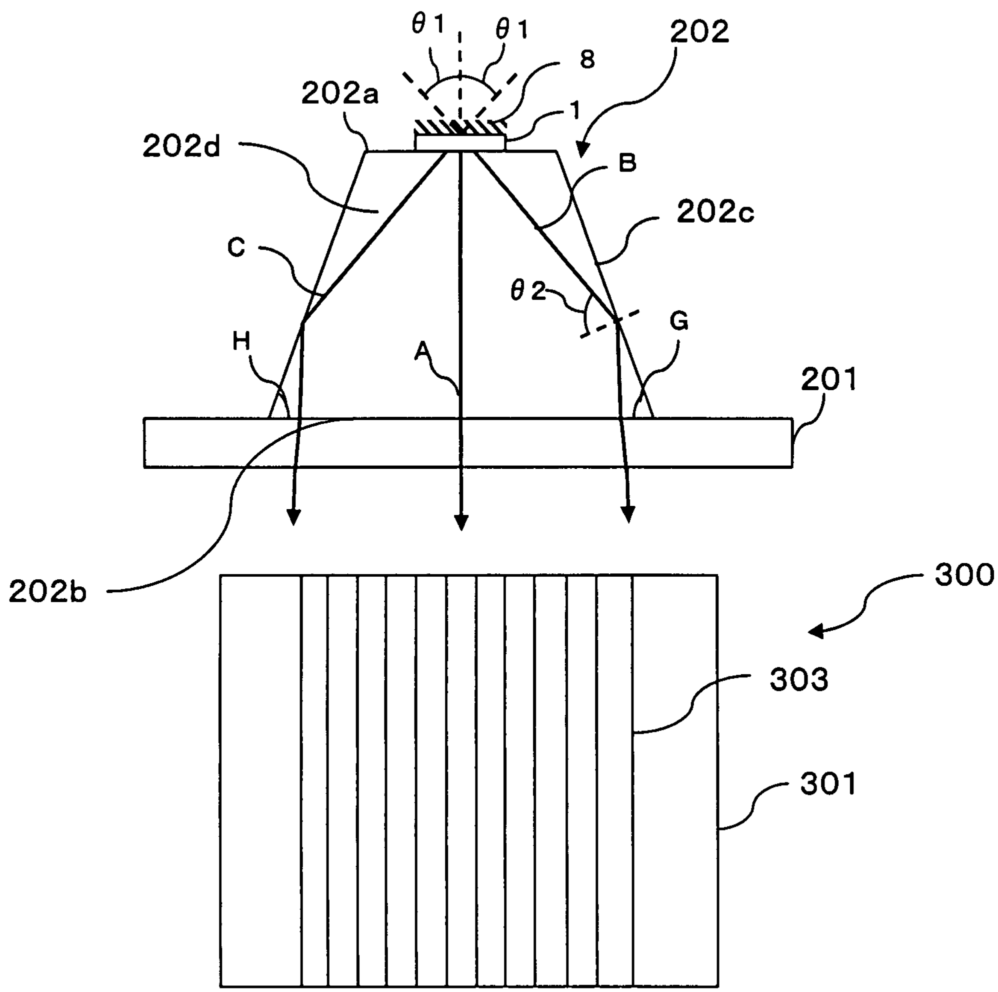


FIG. 8

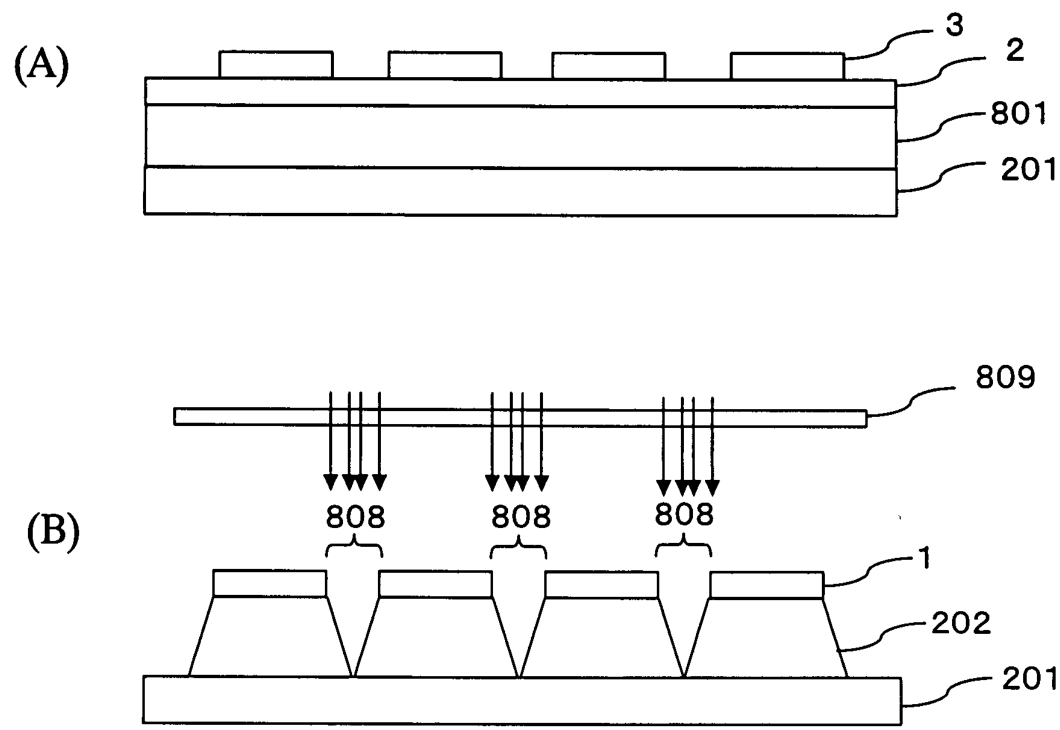


FIG. 9

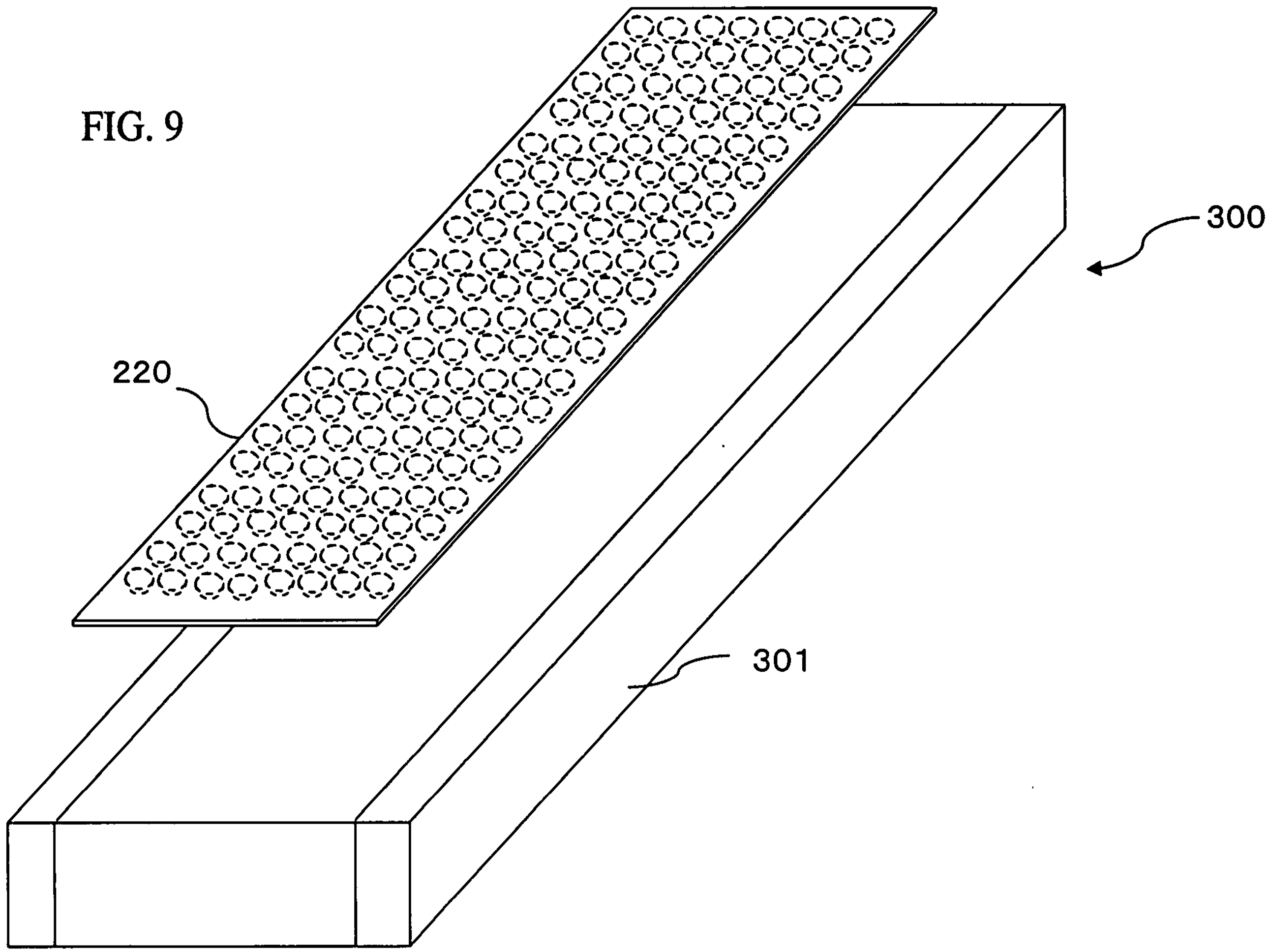
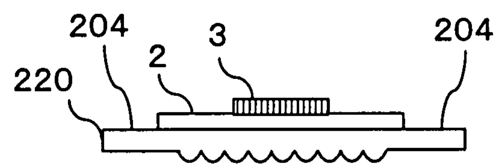
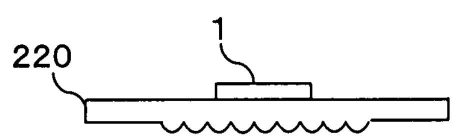


FIG. 10

(A)



(B)



(C)

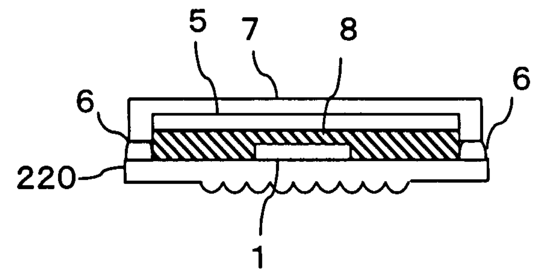


FIG. 11

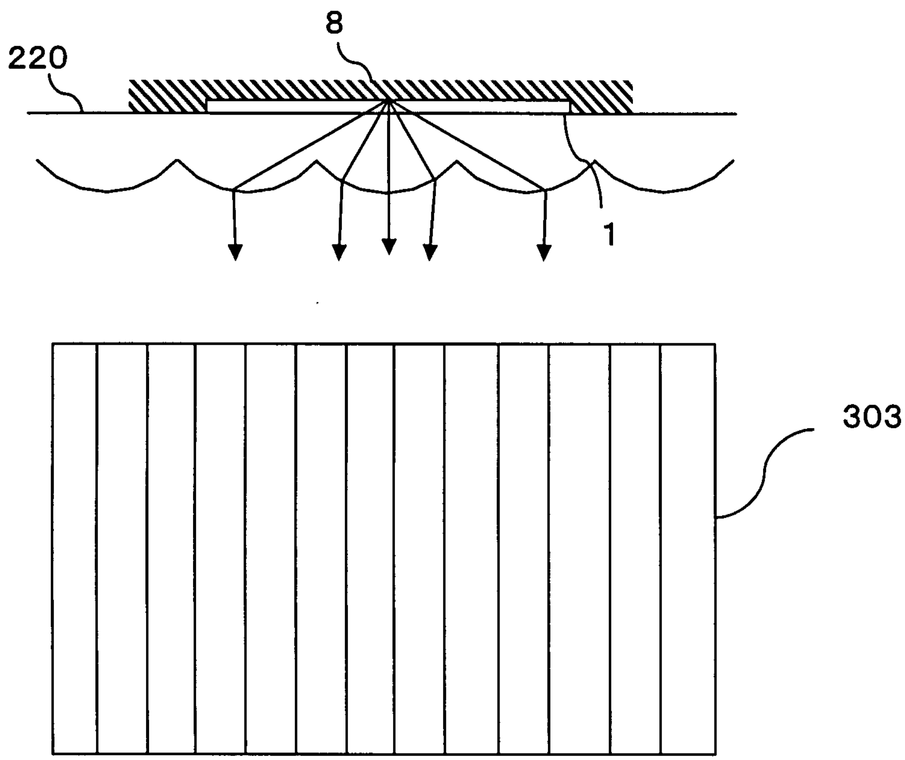


FIG. 12

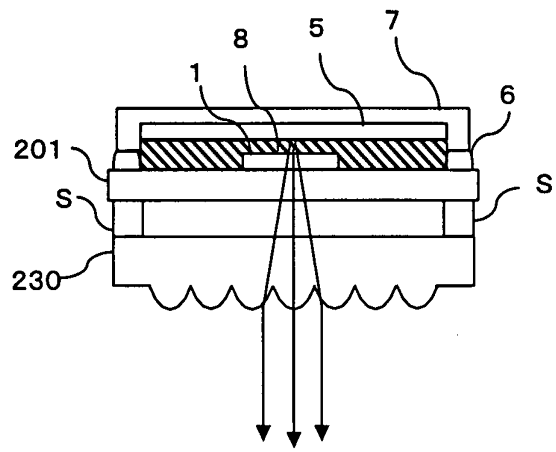


FIG. 13

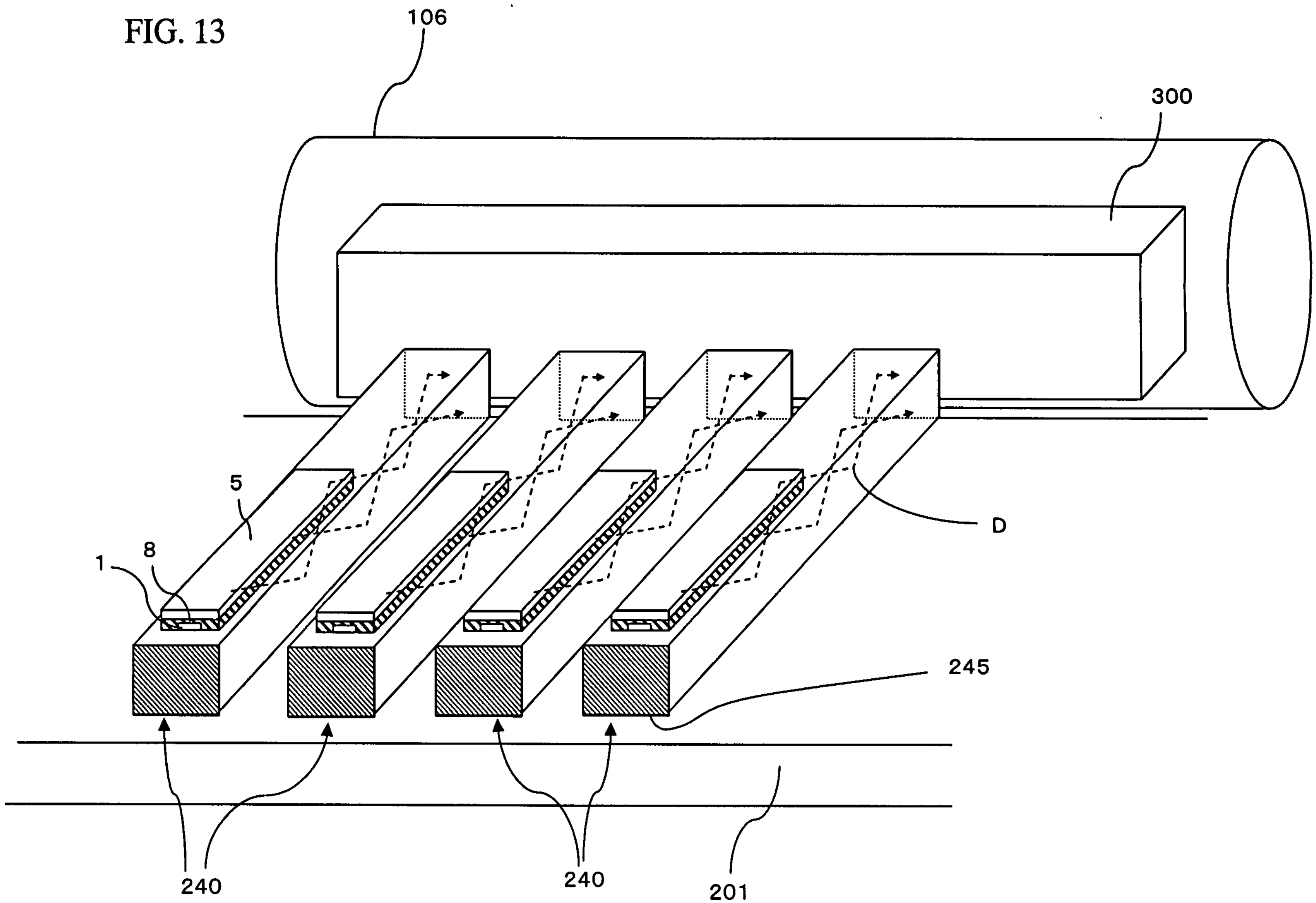


FIG. 14

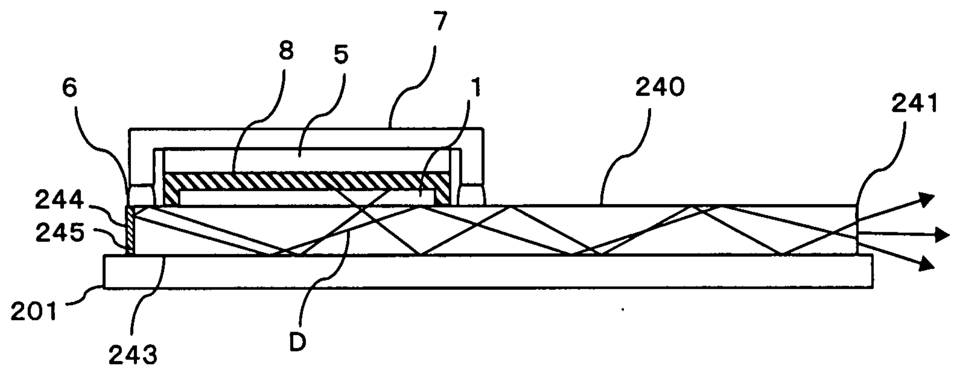


FIG. 15

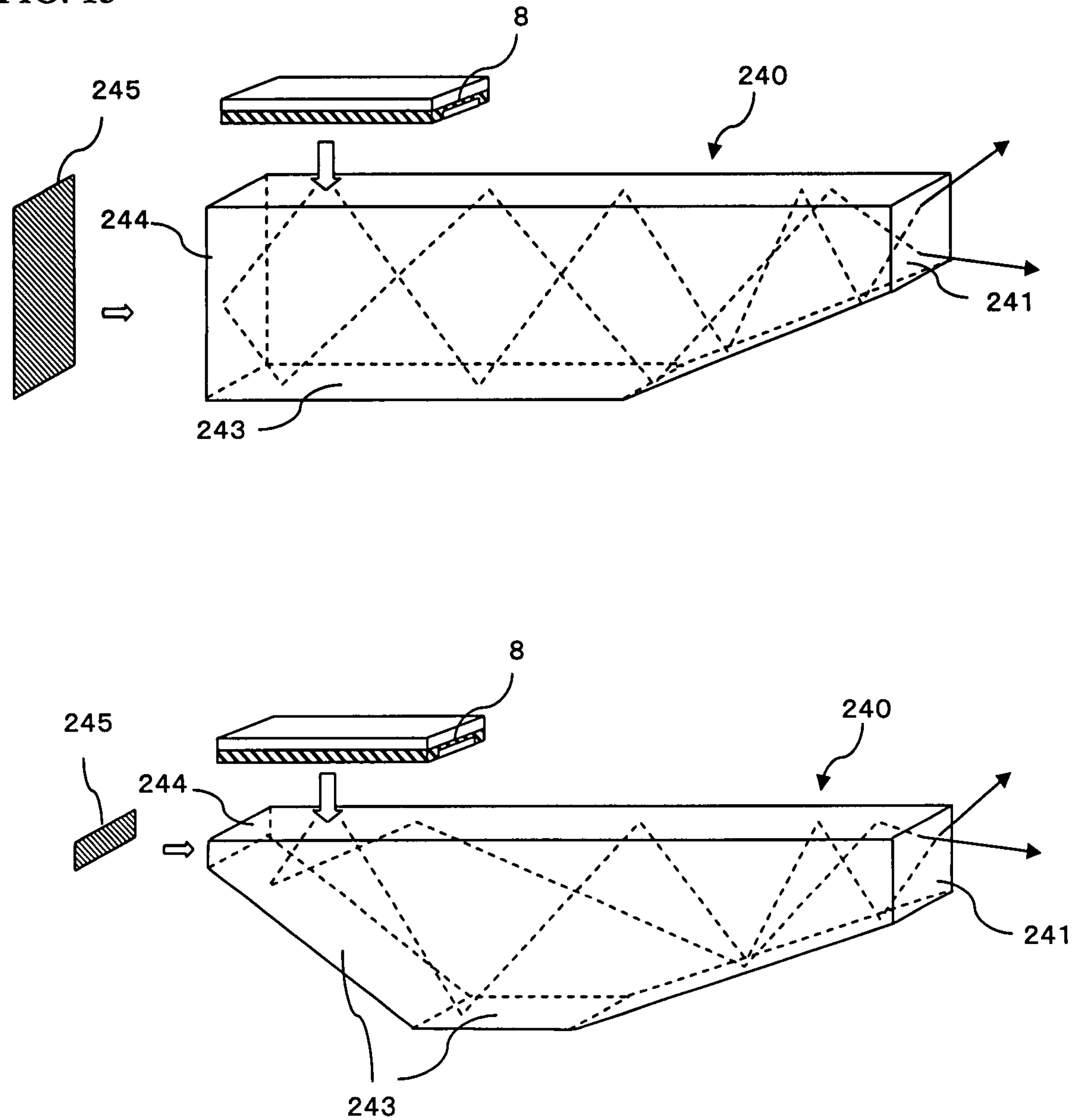


FIG. 16

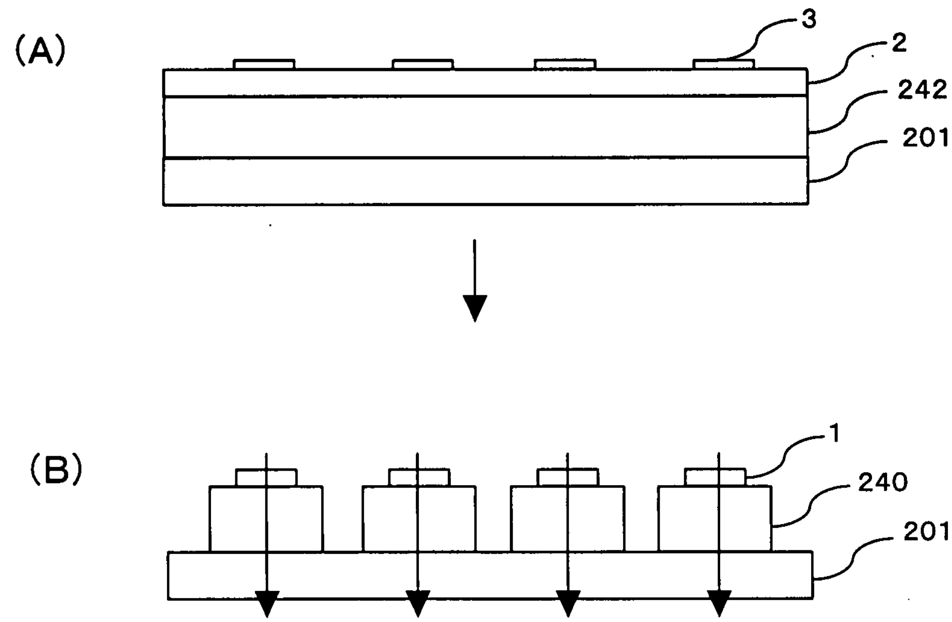


FIG. 17

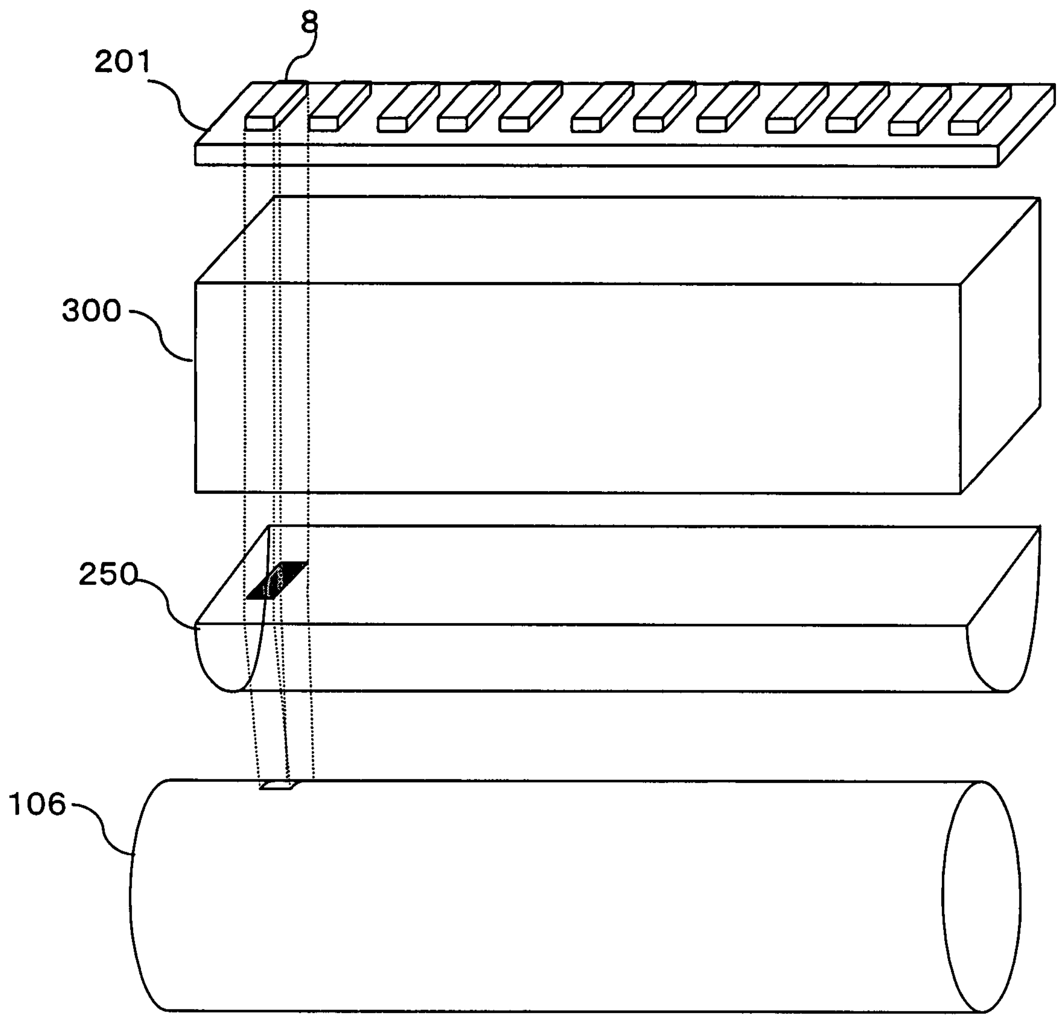


FIG. 18

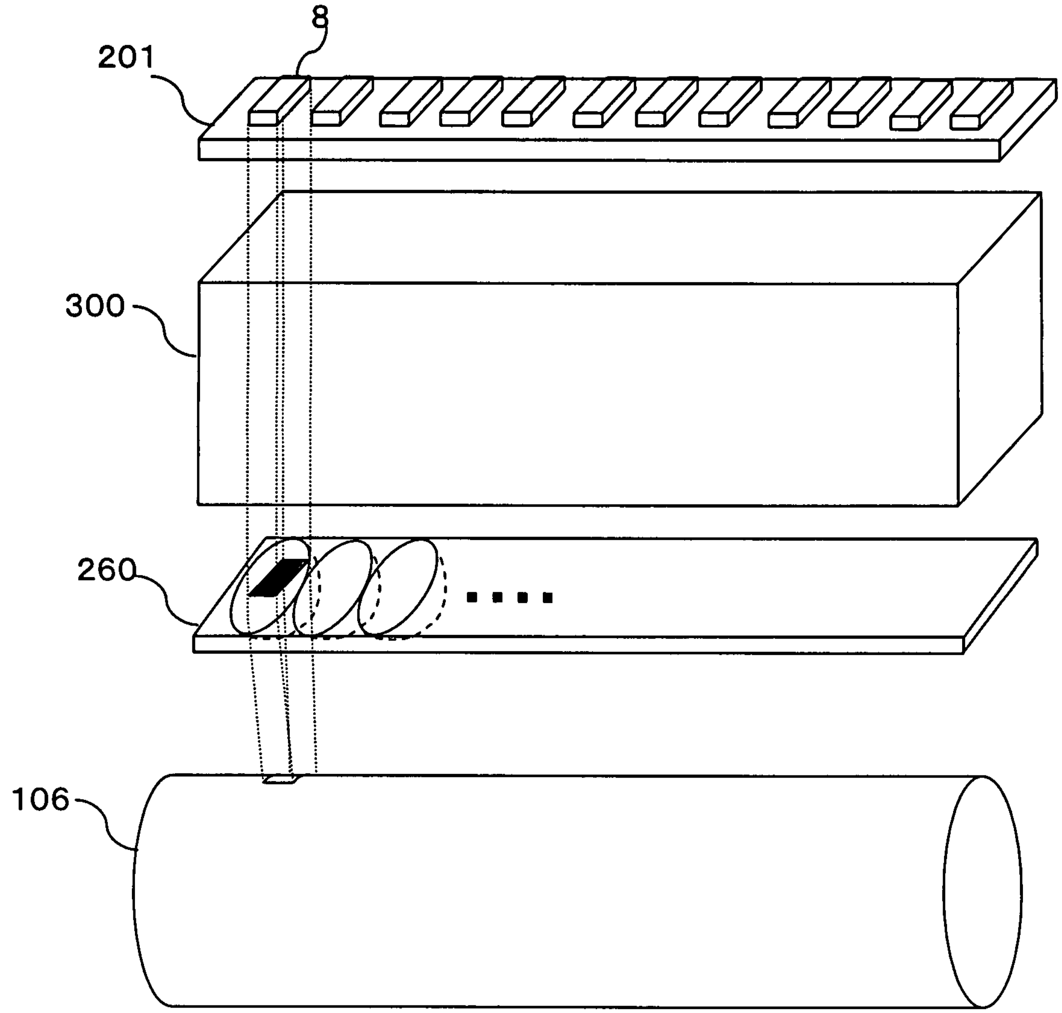


FIG. 19

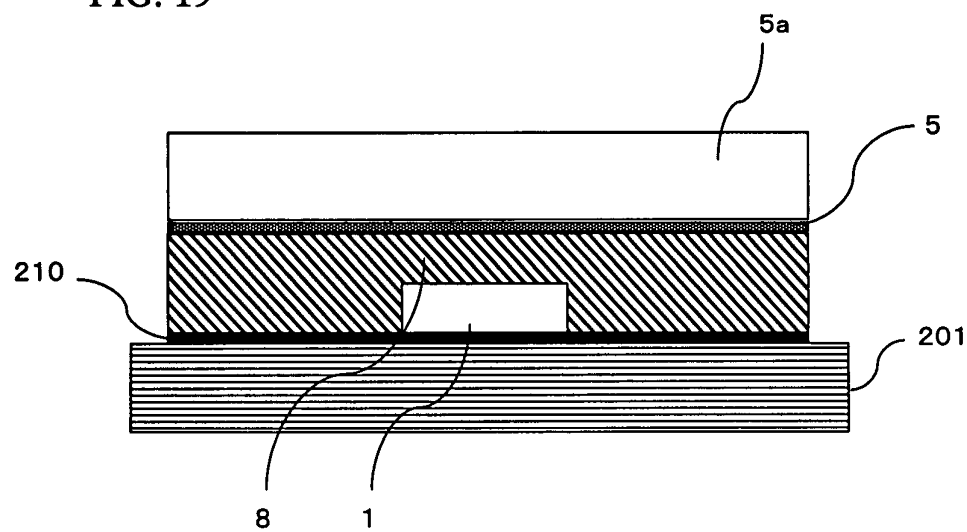


FIG. 20

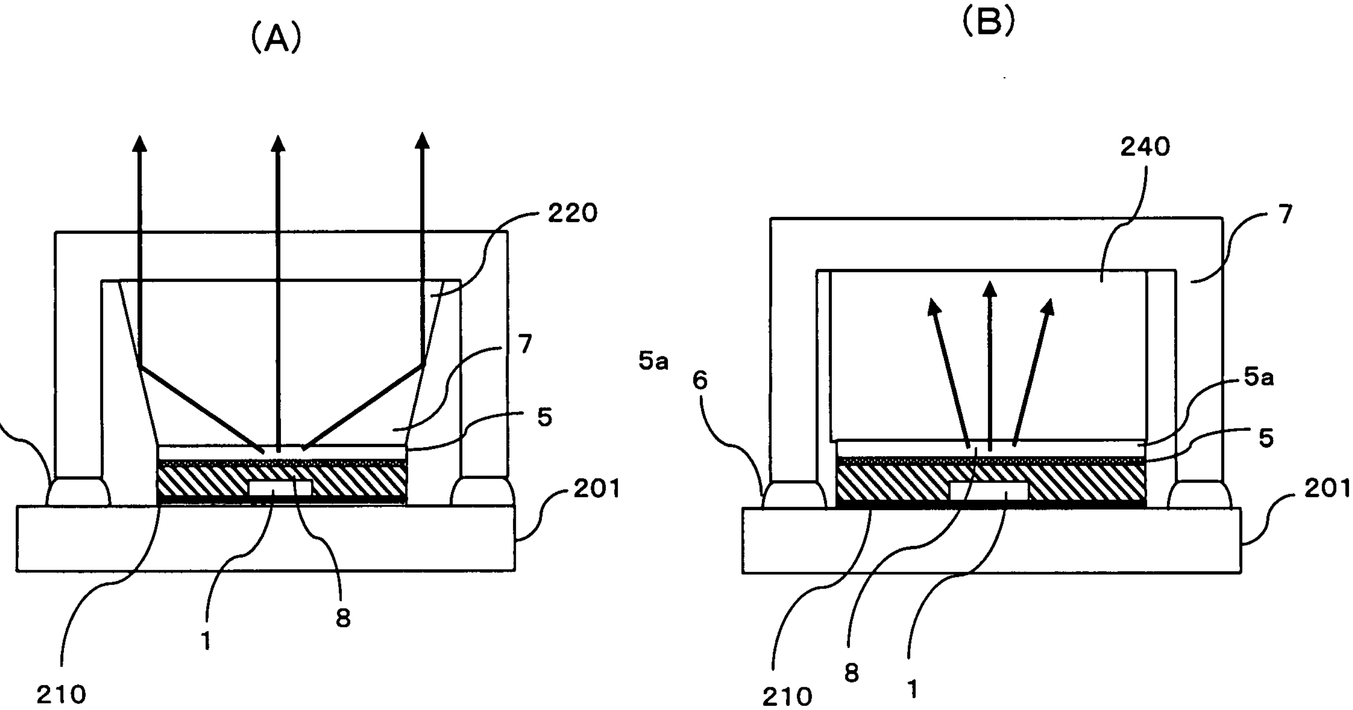


FIG. 21